

What is claimed is:

1. A method of synchronizing an earth terminal in a satellite communication network, the method comprising:

(a) maintaining a downlink symbol counter clocked at a downlink clock rate;

(b) determining a downlink symbol count representative of a time of arrival at a satellite of a burst transmitted from an earth terminal;

(c) adjusting said downlink symbol counter to correspond to said downlink symbol count; and

(d) transmitting bursts from said earth terminal to said satellite in accordance with said downlink symbol counter.

2. The method of claim 1 further comprising extracting a downlink symbol counter clock from said downlink signal.

3. The method of claim 1 further comprising determining a length L of a propagation path between said satellite and said earth terminal.

4. The method of claim 3 further comprising determining an initial estimate of said length L.

5. The method of claim 4 wherein said step of determining an initial estimate of said length L comprises:

(i) storing an earth terminal location in said earth terminal;

(ii) providing a satellite position of said satellite to said earth terminal; and

(iii) determining said initial estimate using said satellite position and said earth terminal location.

6. The method of claim 5 wherein said step of providing a satellite position comprises providing a cell bearing the current coordinates of the satellite.

7. The method of claim 3 further comprising periodically updating the value of said length L.

8. The method of claim 7 wherein said step of periodically updating comprises:

(i) storing an earth terminal location in said earth terminal;

(ii) updating a satellite position of said satellite with said earth terminal;

(iii) redetermining said length L using said satellite position and said earth terminal location.

9. The method of claim 8 wherein said step of updating a satellite position comprises periodically transmitting updated satellite coordinates to said earth terminal.

10. The method of claim 1 wherein said step of determining a downlink symbol count comprises maintaining a downlink frame counter and multiplying by a number of symbols in said downlink frame.

11. The method of claim 10 further comprising adjusting said downlink symbol counter to account for changes in the length L of a propagation path between said satellite and said earth terminal.

12. The method of claim 1 wherein said step of determining a downlink symbol count comprises extracting a downlink frame number from said downlink signal and multiplying by a number of symbols in said downlink frame.

13. The method of claim 12 further comprising adjusting said downlink symbol counter to account for changes in the length L of a propagation path between said satellite and said earth terminal.

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14. The method of claim 7 further comprising:

(i) transmitting a communication signal from said earth terminal to said satellite; and

(ii) receiving a timing error from said satellite.

15. The method of claim 14 further comprising

redetermining said length L using said timing error.

16. The method of claim 15 further comprising storing

said length L in said earth terminal.

17. The method of claim 14 wherein said step of

transmitting a communication signal comprises

transmitting an entry order wire from said earth terminal to said satellite.

18. The method of claim 17 further comprising:

determining an identification of said earth terminal;

providing said identification of said earth terminal a network control center;

generating a synchronization channel assignment for said earth terminal; and

transmitting said synchronization channel assignment to said earth terminal.

19. The method of claim 18 further comprising adjusting said downlink symbol counter according to said timing error.

20. The method of claim 19 wherein said step of adjusting comprises:

launching synchronization bursts from said earth terminal to said satellite in said synchronization channel;

processing said synchronization bursts to determine an uplink timing error associated with said synchronization bursts;

transmitting said uplink timing error to said earth terminal; and

adjusting the value of said downlink symbol counter according to said uplink timing error.

21. The method of claim 20 wherein said step of transmitting said uplink timing error comprises transmitting a correction code indicative of said timing error to said earth terminal.

22. The method of claim 21 wherein said step of transmitting a correction code comprises transmitting a code representing one of an early indication or a late indication.

1 23. The method of claim 21 wherein said step of
2 transmitting a correction code comprises transmitting a
3 multi-bit code representing one of an early indication, a
4 late indication, or an absent indication.

1 24. The method of claim 21 wherein said step of
2 transmitting a correction code comprises transmitting a
3 code representing one of an early indication, a late
4 indication, an absent indication, or an on time
5 indication.

1 25. The method of claim 19 further comprising storing
2 said timing error.

1 26. The method of claim 25 further comprising, upon re-
2 entry of said earth terminal, adjusting said downlink
3 symbol counter to account for said length L and said
4 stored timing error.

1 27. A synchronization method for a satellite
2 communication network, the method comprising:
3 (a) establishing a communication satellite in orbit;
4 (b) establishing an earth terminal in communication
5 with said satellite;
6 (c) generating a master clock on said satellite;

7 (d) transmitting downlink symbols synchronously with
8 said master clock from said satellite to said earth
9 terminal;

10 (e) maintaining at said earth terminal a downlink
11 symbol counter clocked at a downlink clock rate;

12 (f) determining a downlink symbol count
13 representative of a time of arrival of a burst
14 transmitted from an earth terminal to a satellite;

15 (g) adjusting said downlink symbol counter to
16 correspond to said downlink symbol count upon receipt of
17 a predetermined reference point in a downlink frame; and

18 (h) transmitting bursts from said earth terminal to
19 said satellite in accordance with said downlink symbol
20 counter.

1 28. The method of claim 27 further comprising extracting
2 a downlink symbol counter clock from said downlink
3 signal.

1 29. The method of claim 27 further comprising determining
2 a length L of a propagation path between said satellite
3 and said earth terminal.

1 30. The method of claim 29 further comprising determining
2 an initial estimate of said length L.

1 31. The method of claim 30 wherein said step of
2 determining an initial estimate of said length L
3 comprises:

4 (i) storing an earth terminal location in said earth
5 terminal;

6 (ii) providing a satellite position of said
7 satellite to said earth terminal; and

8 (iii) determining said initial estimate using said
9 satellite position and said earth terminal location.

1 32. The method of claim 31 wherein said step of providing
2 a satellite position comprises providing satellite
3 ephemeris data.

1 33. The method of claim 30 further comprising
2 periodically updating the value of said length L.

1 34. The method of claim 33 wherein said step of
2 periodically updating comprises:

3 (i) storing an earth terminal location in said earth
4 terminal;

5 (ii) updating a satellite position of said satellite
6 with said earth terminal;

7 (iii) redetermining said length L using said
8 satellite position and said earth terminal location.

1 35. The method of claim 34 wherein said step of updating
2 a satellite position comprises periodically transmitting
3 updated satellite coordinates to said earth terminal.

1 36. The method of claim 27 wherein said step of
2 determining a downlink symbol count comprises maintaining
3 a downlink frame counter and multiplying by a number of
4 symbols in said downlink frame.

1 37. The method of claim 36 further comprising adjusting
2 said downlink symbol counter ~~to~~ account for a length L of
3 a propagation path between said satellite and said earth
4 terminal.

1 38. The method of claim 27 wherein said step of
2 determining a downlink symbol count comprises extracting
3 a downlink frame number from said downlink signal and
4 multiplying by a number of symbols in said downlink
5 frame.

1 39. The method of claim 38 further comprising adjusting
2 said downlink symbol counter to account for a length L of
3 a propagation path between said satellite and said earth
4 terminal.

1 40. The method of claim 33 further comprising:
 2 transmitting a communication signal from said earth
 3 terminal to said satellite; and
 4 receiving a timing error from said satellite.

1 41. The method of claim 40 further comprising
 2 redetermining said length L using said timing error.

1 42. The method of claim 41 further comprising storing
 2 said length L in said earth terminal.

1 43. The method of claim 40 wherein said step of
 2 transmitting a communication signal comprises
 3 transmitting an entry order wire from said earth terminal
 4 ~~to said satellite.~~

1 44. The method of claim 43 further comprising:
 2 determining an identification of said earth
 3 terminal;
 4 providing said identification of said earth terminal
 5 a network control center;
 6 generating a synchronization channel assignment for
 7 said earth terminal; and
 8 transmitting said synchronization channel assignment
 9 to said earth terminal.

45. The method of claim 44 further comprising adjusting said downlink symbol counter according to said timing error.

46. The method of claim 45 wherein said step of adjusting comprises:

launching synchronization bursts from said earth terminal to said satellite in said synchronization channel;

processing said synchronization bursts to determine an uplink timing error associated with said synchronization bursts;

transmitting said uplink timing error to said earth terminal; and

adjusting the value of said downlink symbol counter according to said uplink timing error.

47. The method of claim 46 wherein said step of transmitting said uplink timing error comprises transmitting a correction code indicative of said timing error to said earth terminal.

48. The method of claim 47 wherein said step of transmitting a correction code comprises transmitting a code representing one of an early indication or a late indication.

1 49. The method of claim 47 wherein said step of
2 transmitting a correction code comprises transmitting a
3 multi-bit code representing one of an early indication, a
4 late indication, or an absent indication.

1 50. The method of claim 47 wherein said step of
2 transmitting a correction code comprises transmitting a
3 code representing one of an early indication, a late
4 indication, an absent indication, or an on time
5 indication.

1 51. The method of claim 45 further comprising storing
2 said timing error.

1 52. The method of claim 51 further comprising, upon re-
2 entry of said earth terminal, adjusting said downlink
3 symbol counter to account for said length L and said
4 stored timing error.

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